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Roman Aqueducts

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Introduction

Access to safe, clean drinking water is essential for any city's survival. This was especially difficult but still necessary for cities in antiquity. Rome was able to construct conduits that provided enough water to supply its citizens and clean the sewer systems. This was an engineering feat that was unsurpassed by other states in the ancient world.

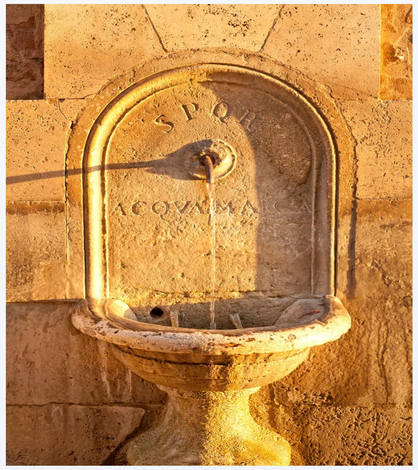

Photo Credit: Getty Images

History

- Our main source of the aqueducts was Sextus Julius Frontinus, who held the position of Water Commissioner at the end of the first century A.D.
- Within a period of five centuries, the Romans had constructed eleven aqueducts to provide Rome with water (Matera, 1977, pg. 252)
- Aqueducts replaced earlier forms of water distribution that used conduits entirely under the ground
- The first aqueducts did not use mortar, although later forms did
- The Aqua Marcia was the longest of the Roman aqueducts, stretching nearly 60 miles
- The successors to some of the original aqueducts are still in use today

Materials and Design

There are three distinct types of aqueducts that the ancient Romans built: cut-stone, concrete faced with stone, and concrete and brick

- The earliest versions are made from cut-stone
  - –One of the earliest was the Aqua Marcia, which was constructed in 144 BC
- This later evolved into concrete faced with stone
  - –Stacking of aqueducts began with these versions
  - –The Aqua Tepula and the Aqua Julia were stacked onto the Aqua Marcia
- The final version was constructed from concrete and brick
  - –The concrete of this period was unusual as the mortar proportions were smaller than past aqueducts

Photo credit: National Geographic

Mechanics and Water Distribution

- Water was distributed by way of two forms of conduits: open and closed
- Open conduit were the most common used by the Romans and consisted of channels built into stone and waterproofed by plaster or cement
- Open conduits needed a consistent slope to keep the water level even, normally a gradient between 1 in 150 and 1 in 500
- Closed conduits normally consisted of a rounded waterproof pipe
- Water flow was from only gravity sending it through distribution tanks
- Water wasn't stored
- Channels bored through rock from intaker to distribution tank
- Vertical shafts bored at interval for ventilation and access
- The final stretch was raised on arches to give sufficient head for distribution within the city
- The aqueducts took roundabout routes to ensure gradient constant
- Followed land contours and headed along spurs leading to final city
- High arches were used to support the conduits across valleys and plains

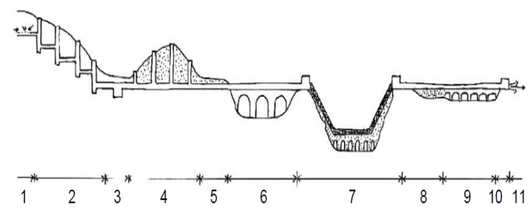

Figure 3 Figure of the Roman Aqueduct water supply system: (1) Source (in this case: infiltration gallery); (2) Steep chutes (in this case: dropshafts); (3) Settling tank; (4) Tunnel and shafts (putei); (5) Covered trench; (6) Aqueduct bridge; (7) (inverted) Siphon; (8) Substruction; (9) Arcade and culverts; (10) Distribution basin/castellum divisorium; (11) Water distribution (in this case with (lead) pipes into the town) (Schram, 2004)

Photo credit: Schram, 2004

Conclusions

The Romans were considered the greatest builders of aqueducts in the ancient world, even though they weren't the first. Overtime, they continued to improve these aqueducts, totaling 3 different types, first cut-stone, second concrete, and third brick. They built these all through their empire to not just deliver safe drinking water, but to also flush the sewer systems with the excess water. Overtime they were able to start building aqueducts over plains by using high arches.

Photo Credit: TripAdvisor

References

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